

E. Grounding

Install ground rods for each structural support adjacent to the foundation with the conduit as indicated below:

1. Vertically drive single, 8 ft (2.4 m) long ground rods until the top of the rod is at least 12 in. (300 mm) below the finished ground.
2. Attach a length of #6 bare copper, 7-strand wire to the ground with suitable ground rod clamps and connect it to the grounding nut of the column.
3. If sufficient penetration cannot be obtained in the above manner, place a ground rod system consisting of 3 parallel ground rods a minimum of 6 ft (1.8 m) center-to-center in a horizontal pattern and at least 12 in. (300 mm) below the finished ground. Join these rods and connect them to the grounding nut of the column with #6 bare copper, 7-strand wire and suitable ground rod clamps.

F. Finished Ground Surface

Ensure that the finished ground surface matches the typical section adjacent to the structural support. Do not adjust the ground surface around the stem to obtain 12 in (300 mm) minimum projection above finished ground surface.

638.3.06 Quality Acceptance

General Provisions 101 through 150.

638.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

638.4 Measurement

The quantity measured for payment shall be each structure type at the specified location completed and accepted. This shall include design, fabrication, and construction of structural supports including anchor bolt assemblies, foundations, excavation, backfill, redressing, and regrassing; but exclusive of signs.

638.4.01 Limits

General Provisions 101 through 150.

638.5 Payment

This item, measured according to Subsection 638.4, "Measurement," for each structural support for overhead highway signs, is paid for at the Lump Sum Contract Unit Price bid for the complete structure.

Payment will be made under:

| | | |
|--------------|--|--------------|
| Item No. 638 | Structural support for overhead highway sign, type I—sta.____ | Per lump sum |
| Item No. 638 | Structural support for overhead highway sign, type II—sta.____ | Per lump sum |
| Item No. 638 | Structural support for overhead highway sign, type III—sta.____ | Per lump sum |
| Item No. 638 | Structural support for overhead highway sign, type IV—sta.____ | Per lump sum |
| Item No. 638 | Structural support for overhead highway sign, type V—sta.____ | Per lump sum |
| Item No. 638 | Structural support for overhead highway sign, type VI—sta.____ | Per lump sum |
| Item No. 638 | Structural support for overhead highway sign, type VII—sta.____ | Per lump sum |
| Item No. 638 | Structural support for overhead highway sign, type VIII—sta.____ | Per lump sum |

638.5.01 Adjustments

General Provisions 101 through 150.

Section 639—Strain Poles for Overhead Sign and Signal Assemblies

639.1 General Description

This work includes furnishing and erecting overhead sign and signal support strain poles and steel wire strand cable according to this Specification and the Plans.

Make concrete or steel strain poles at any one location within the Project from the same material unless the Plans designate a particular type for that location.

Use timber strain poles only where designated on the Plans.

639.1.01 Definitions

General Provisions 101 through 150.

639.1.02 Related References

A. Standard Specifications

Section 500—Concrete Structures

Section 636—Highway Signs

Section 852—Miscellaneous Steel Materials

Section 861—Piling and Round Timber

Section 863—Preservative Treatment of Timber Products

Section 865—Manufacture of Prestressed Concrete Bridge Members

Section 915—Mast Arm Assemblies

B. Referenced Documents

ASTM A 27 / A 27 M

ATSM A 36 / A 36 M

ASTM A 123 / A 123 M

ASTM A 153 / A 153 M

ASTM A 242 M

ASTM A 595

ASTM A 709(A 709 M)

639.1.03 Submittals

For steel and prestressed concrete strain poles, prepare drawings and other data that give the pole dimensions and design. Submit them to the Bridge Engineer for approval before beginning construction.

Ensure that the total deflection of strain poles resulting from the dead load plus the live load is equal to or less than 2.5 percent of the pole height measured from the ground line to the point at which the load is applied.

639.2 Materials

Ensure that materials meet the requirements of the following Specifications:

| Material | Section |
|--------------------------------------|----------------|
| Class A Concrete | 500 |
| Class B Concrete | 500 |
| Class AAA Concrete | 500 |
| Timber Poles | 861.2.02 |
| Seasoning and Preservative Treatment | 863.2.01 |
| Steel Wire Strand Cable | 915.2.02 |
| Guys and Anchors | Per Plans |

A. Steel Strain Poles

Use shafts for steel strain poles fabricated of steel that conforms to one or more of the following:

- ASTM A 242/A 242 M
- ASTM A 709 Grade 50W (A 709 M Grade 345W)
- ASTM A 595
- AISI 1015
- AISI 1020
- SAE: 1015

Ensure that the steel characteristics or strength do not change significantly from welding.

1. Shaft

Use the appropriate shape of shaft which is a continuous taper and is constructed of corrosion resistant steel, unless otherwise specified, to the dimensions required for the specified classification type.

Form the shaft from one piece with one electrically welded longitudinal joint and no intermediate horizontal joints.

2. Pole

Use a pole with a mill certified yield strength of at least 48,000 psi (331 MPa). After forming and welding the pole, the shaft may be longitudinally cold rolled under enough pressure to flatten the shaft to conform to the required yield strength. For Type IV steel strain poles, ensure that the wall thickness is at least 3 gauge or 0.25 in. (6 mm).

3. Traffic Signal Strain Poles

Assemble traffic signal strain poles as follows:

- a. Weld a handhole assembly, curved on the front to follow the contour of the pole, into the shaft near the base.
- b. Include a tapped hole on the handhole reinforcing frame to accommodate the grounding lug.
- c. Secure the cover to the frame using at least two screws.
- d. Weld a J-hook wire support inside near the top of the shaft for the poles.
- e. If an overhead power source is shown, use a clamp and clevis device to connect the wire to the pole and provide a weatherproof wire inlet close to the attachment. Conceal the other wiring to and from the controllers within the pole.

For traffic signal strain poles with mounted controller cabinets, provide a 2 in. (50 mm) half coupling wire inlet to mount the controller cabinet on the designated pole. Ensure that the location where cable enters the wire inlets at the top of the traffic signal strainpoles has a neat design and appearance. Do not use junction boxes at the top of poles to facilitate cable entrances.

4. Grounding

Provide a 0.5 in (13 mm) approved grounding connector in the shaft. Equip the top of the shaft with a removable cap held securely in place.

Hot-dip galvanize the shaft according to ASTM A 123/A 123 M unless otherwise specified.

5. Base

Secure to the lower end of the shaft a one-piece cast steel base or a one-piece flat plate base that meets the requirements of ASTM A 27, Grade 65-35/A27 M Grade 450-240, or A 36/ A 36 M, as required.

- a. Ensure that the base, after welding, develops the full strength of the adjacent shaft section to resist bending.
- b. Attach the base to the concrete foundation with four bolts according to this subsection.
- c. Provide four removable cast or pressed steel ornamental covers with each base, and attach it to the base.

6. Anchor Bolts

Furnish each pole with four anchor bolts of the size required in the manufacturer's Shop Drawings. Ensure that the anchor bolts meet the requirements of Subsection 852.2.02.

Galvanize the threaded portions according to ASTM A 153/A 153 M and the Plan details.

B. Prestressed Concrete Strain Poles

Use shafts for these poles that comply with Subsection 865.2.01.B, except give the poles a steel trowel finish on the unformed side and any required pointing to eliminate air and water holes left by the steel forms. Use Class AAA concrete.

Use a marking tool to identify the pole class and height, or cast it with a die in the front face of the pole to produce letters and numbers at least 2 in (50 mm) high and wide.

C. Miscellaneous Hardware

Use hardware for steel and concrete strain poles with these features:

1. The steel required to fabricate other structural components is weldable and conforms physically and chemically to applicable ASTM specifications.
2. Nuts, bolts, and screws conform to these diameter requirements:
 - If diameters are less than 0.5 in (13 mm), the hardware is passivated stainless steel that meets the requirements of AISI 300, commercial grade.
 - If diameters are 0.5 in (13 mm) and larger, the hardware conforms to ASTM physical and chemical qualifications that ensure strength commensurate with the parts being connected. Galvanize the hardware according to ASTM A 153/A 153 M.
3. Use galvanized steel ground rods 5/8 in (16 mm) diameter, $\pm 1/16$ in, (± 1.6 mm) and 8 ft (2.4 m) long unless otherwise specified.

Ensure that galvanizing has a coating of at least 2 oz/ft² (610 g/m²) according to ASTM A 153/A 153 M.

639.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

639.3 Construction Requirements

639.3.01 Personnel

General Provisions 101 through 150.

639.3.02 Equipment

General Provisions 101 through 150.

639.3.03 Preparation

General Provisions 101 through 150.

639.3.04 Fabrication

General Provisions 101 through 150.

639.3.05 Construction

A. Timber Poles

Construct the following according to the Plan:

1. Excavate the hole to the proper diameter and depth.
2. Erect the pole to an out-of-plumb position with its base resting on the bottom of the hole.
Hold the pole in its out-of-plumb position until the cavity around the pole is filled with Class B or better concrete and is set and cured for at least 7 days. Then, apply tension to the pole.

B. Steel Poles

Construct the steel poles the same as the timber poles as described in Subsection 639.3.05.A, "Timber Poles."

C. Prestressed Concrete Poles

Drill round holes or dig square holes for prestressed concrete poles.

1. Do not disturb the natural ground adjacent to the foundation more than necessary to construct the foundation.
2. Excavate to the lines and elevations shown on the Plans or established by the Engineer.
 - a. Dispose of the excavated materials as directed.
 - b. Regrade and grass the disturbed areas to match the contiguous area.
3. Backfill according to the Plans. Furnish and place Class A concrete, as required, according to the applicable portions of Section 500 and Plan details.
4. When leaving lifting eyes or loops on the pole to facilitate handling and erecting, burn them off and patch them after erecting.

D. Ground Rods

Install ground rods for steel and prestressed concrete strain poles adjacent to the strain pole base as follows:

1. Vertically drive the single ground rods 8 ft (2.4 m) long until the top of the rod is at least 12 in (300 mm) below the finished ground.
2. Use ground rod clamps to attach a length of No. 6 AWG bare copper, 7-strand wire to the ground rod. Connect the wire to the grounding nut of the strain pole base.
3. When penetration cannot be obtained in the above steps, place three parallel ground rods at least 6 ft (1.8 m) center-to-center in a horizontal pattern and at least 12 in (300 mm) below the finished ground.

Join the rods and connect them to the grounding nut of the pole base with No. 6 AWG bare copper, 7-strand wire and ground rod clamps.

E. Rake

Use the proper rake to erect the pole so that the pole will be plumb after the load is applied.

F. Erecting Cable

Follow these steps to erect the cable:

1. Install the top cable 6 in (150 mm) from the top of the pole, unless otherwise indicated on the Plans.
2. Install the bottom cable no more than 5 ft (1.5 m) from the top of the pole according to Plan details.
3. Secure the cable to each pole as shown on the Plans. Use preformed cable grips instead of cable clamps, if necessary.
4. Apply enough tension to pull timber poles toward each other past the plumb position by one degree.

639.3.06 Quality Acceptance

General Provisions 101 through 150.

639.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

639.4 Measurement

Highway signs are measured and paid for under Section 636.

A. Treated Timber Poles

Treated timber poles of the class and length specified are measured by the number of units installed, including guys, anchors, and hardware.

B. Steel Cable

Steel cable of the specified size are measured by the linear foot (meter), complete in place.

C. Steel Strain Poles

Steel strain poles are classified and measured for payment by each unit and by type according to the following table:

| Type | Span Length |
|------|----------------------------|
| I | Less than 60 ft (18 m) |
| II | 60 to 95 ft (18 m to 29 m) |
| III | Greater than 95 ft (29 m) |
| IV | Traffic signal strain pole |

D. Prestressed Concrete Strain Poles

Prestressed concrete strain poles are measured for payment by each unit and pole type as specified in the above table.

639.4.01 Limits

General Provisions 101 through 150.

639.5 Payment

A. Treated Timber Poles

Treated timber poles of the class and length specified will be paid for at the Contract Price bid per each. Payment is full compensation for poles, concrete encasements, excavation for pole and anchor holes, temporary pole alignment, bracing, guys, and items to complete the Work.

B. Steel Strain Poles

Steel strain poles of the type specified, complete in place and accepted, including backfill, erection, and necessary regressing will be paid for at the Contract Unit price bid for each pole of each type.

C. Prestressed Concrete Strain Poles

Prestressed concrete strain poles of the type specified, complete in place and accepted, including backfill, erection, and necessary regressing will be paid for at the Contract Unit Price bid for each pole of each type.

When neither concrete nor steel strain poles are specified, either type is acceptable. Measurement is specified in Subsections 639.4.C. or 639.4.D. The payment item is Strain Poles, Type ____.

D. Steel Cable

Steel cable complete in place and accepted will be paid for at the Contract Unit Price bid per linear foot (meter) of each specified diameter. Payment is full compensation for furnishing and erecting the cable and for providing hardware including thimbles, but not hardware that is a part of the pole.

Payment will be made under:

| | | |
|--------------|--|-------------------------|
| Item No. 639 | Treated timber pole class____, ____ ft (m) | Per each |
| Item No. 639 | Steel strain pole, type____ | Per each |
| Item No. 639 | Prestressed concrete strain pole, type____ | Per each |
| Item No. 639 | Strain Poles, Type____ | Per each |
| Item No. 639 | Steel strand wire cable____in. (mm) | Per linear foot (meter) |

639.5.01 Adjustments

General Provisions 101 through 150.

Section 640—Retroreflectorized Railroad Cross Buck Sign

640.1 General Description

This work includes furnishing and erecting retroreflectorized railroad cross buck signs, including wood or steel posts and concrete bases for steel posts at locations shown on the Plans or as directed by the Engineer.

640.1.01 Definitions

General Provisions 101 through 150.

640.1.02 Related References

A. Standard Specifications

Section 500—Concrete Structures

B. Referenced Documents

Specifications of the Association of American Railroads

MUTCD

640.1.03 Submittals

General Provisions 101 through 150.